Remarks

Thorough examination by the Examiner is noted and appreciated.

The Specification has been amended to correct grammatical errors and overcome Examiner objections.

The claims have been amended to clarify Applicants disclosed and claimed invention and overcome Examiners objections and rejections. The amendments find support in the original claims and/or the Specification. No new matter has been added.

Claim Objections

The claims 10 and 18 have been amended to overcome Examiners objections as helpfully suggested by Examiner.

Double patenting

Claim 27 has been cancelled to overcome Examiners objection.

Claim Rejections under 35 USC 112

Claim 20 has been amended to overcome Examiners rejection.

Claim Rejections under 35 USC 102

1. Claims 1-5 stand rejected under 35 USC Section 102(b) as being anticipated by Kagiwata (US 6,433,406).

Kagiwata discloses a fuse structure and a method for manufacturing the same, where fuse elements are formed on a first insulating layer and a portion of the first insulating layer is removed on either side of the fuse elements (between fuse elements) to form grooves between the fuse elements extending to a level below the bottom level of the fuse elements, and forming a second insulating layer disclosed to be silicon nitride or oxide/silicon nitride which covers the sides and upper surfaces of the fuse elements and the inner surface of the grooves (see Abstract; Figures 4A-4B; col 4, lines 1-8; lines 17-30; col 5, lines 64- col 6, line 4; col 7, lines 37-43; col 8, lines 16-24).

Kagiwata further discloses that the fuse elements may be made of aluminum or copper where each fuse element is provided with barrier films on the upper and lower layers of the fuse

element (col 5, lines 52-54).

Kagiwata further discloses in the prior art a similar structure where a silicon nitride film (item 110 (Figures 1B-1D, Figure 2C) is formed over the fuse elements, and may include a groove (item 113, Figure 2C) formed between the fuse elements.

Kagiwata teaches in all the embodiments, and in the disclosed prior art, that the silicon nitride film is subsequently blown away by a laser to form a crater (recess) around the fuse elements (col 1, lines 40-53; col 6, lines 39-54), where it is taught that the silicon nitride film is critical to appropriate operation of the fuse blowing operation.

Kagiwata does not disclose several aspects of Applicants disclosed and claimed invention including:

With respect to claim 1, Kagiwata does not disclose:

"at least two top metal lines in said top inter-metal dielectric layer, said at least two top metal lines comprising a topmost metal layer in electrical communication with at least one lower metal layer comprising a first metal layer;

a fuse on said top inter-metal dielectric layer, said fuse providing electrical communication between said at least two top metal lines by spanning a distance between said

at least two top metal lines;"

For example, see items 106 and 107 (Figure 1B). Rather Kagiwata disclose a moisture proof ring structure (item 103; Figure 1C) surrounding and unconnected to the fuse structure. The moisture proof ring structure is disclosed to be electrically connected through wiring (metal) layers (see col 1, lines 54-60).

Kagiwata further does not disclose:

"a protective layer on said fuse; and

a window formed through a thickness portion of the protective layer, said window positioned over a top portion of said fuse. "

Since Kagiwata fails to disclose the elements of Applicant disclosed and claimed invention claim, Kagiwata fails to disclose the elements of Applicant independent claims.

With respect to claim 5, Applicants reiterate the above comments with made with respect to claim 1.

Moreover, Kagiwata fails to disclose the material of the wiring with respect to the fuses,

but merely disclose that the fuse elements may be made of "a material for usual metal wiring, such as aluminum or copper" (col 5, lines 59-61).

Kagiwata is clearly insufficient to make out a *prima facie* case of obviousness with respect to Applicants disclosed and claimed invention.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

"The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

2. Claims 14-15 stand rejected under 35 USC Section 102(b) as being anticipated by Kajita et al. (JPO020011093981 A)).

Kajita et al. teach using copper wiring in a redundancy circuit where the fuse is formed of Al or an alloy of Al, since Al (or alloy) has a smaller diffusion coefficient than copper, thereby preventing splashed fuse material "from diffusing up to transistors formed on a silicon substrate" (see Solution).

Thus, Kajita et al. do not disclose several aspects of Applicants disclosed and claimed invention.

Kajita et al. do not disclose Applicants disclosed and claimed fuse structure and wiring structure:

"A semiconductor device including a fuse comprising a first layer comprising a **copper island disposed** in a **low dielectric material** inter-metal dielectric layer and a second layer overlying the first layer, wherein the second layer comprises aluminum; and,

a fuse window disposed over said second layer, said fuse window extending through a thickness portion of at least one dielectric layer overlying said fuse."

Kajita et al. is clearly insufficient to make out a *prima facie* case of obviousness with respect to Applicants disclosed and claimed invention.

Claim Rejections under 35 USC 103

1. Claims 6-9, and 22 stand rejected under 35 USC 103(a) as being unpatentable over Kagiwata, above, in view of Kajita et al.

Applicants reiterate the comments made above with respect to Kagiwata and Kajita et al.

As with the insufficiency of Kagiwata alone, the combination of Kagiwata and Kajita et al. fail to disclose several elements of Applicants disclosed and claimed invention.

Neither Kagiwata nor Kajita et al. disclose Applicants claimed fuse structure including low dielectric material as disclosed and claimed by Applicants, nor a window over the fuse structure, nor a silicon dioxide layer on said fuse.

In addition with respect to claim 22, there is no indication that the fuses of Kajita et al. are blown by a laser or an applied Voltage.

Nevertheless, even assuming *arguendo* proper motivation for combining the teachings of Kagiwata and Kajita et al., such combination does not produce Applicants disclosed and claimed invention.

Moreover, there is no recognition in the cited art of the problem that Applicants have recognized and solved by their disclosed and claimed invention: "a semiconductor device fuse structure to prevent dielectric layer cracking at corner portions of associated metallization

structures"

"Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).*

2. Claim 10 stands rejected under 35 USC 103(a) as being unpatentable over Kagiwata, above, in view of Kajita et al. as applied to claim 6 above, and further in view of Ying et al. (US 6,300252).

Since the cited references, singly or in combination, fail to make out a *prima facie* case of obviousness with respect to Applicants independent claims, neither has a *prima facie* case been made out with respect to the dependent claims.

Examiner admits that neither Kagiwata nor Kajita et al. teach an "etch stop layer". Examiner contends the term "etch stop" amounts to functional language rather than indicating material construction. Examiner argues that the functional language must result in a structural difference from the prior art.

However, the prior art does not disclose a structure including etch stop layers or any other layers producing the structure Applicants have disclosed and claimed. In addition, contrary to Examiners assertion, the stated function "etch stop" clearly states a material of construction necessary to resist an etching process, and would be so recognized by persons of ordinary skill in the art.

Since the combination of the structures of Kagiwata and Kajita et al. do not show Applicants metallization interconnect structures, or fuse window structure, Examiner has no basis for asserting obviousness of providing etch stop layers as Applicants have disclosed and claimed.

On the other hand Ying et al. disclose a process for etching a fuse window overlying the fuse. There is no apparent motivation for combining the teachings of Ying et al. with the teachings of Kagiwata or Kajita et al., since neither Kagiwata nor Kajita et al. disclose or suggest a structure having fuse windows. Although Kagiwata discloses etching trenches on either side of a fuse structure, there is no suggestion in Kagiwata that an etch stop layer on "an upper main face and a lower main face of the uppermost inter-metal dielectric layer" would be useful or desirable, and in fact such etch stop layers would undermine the trench etching process of Kagiwata, making the method and structure of Kagiwata unsuitable for its intended purpose.

Even assuming *arguendo* a proper motivation for combining the teachings of Ying et al. and either or both of Kagiwata or Kajita et al., such combination does not produce Applicants disclosed and claimed invention.

2. Claim 12 stands rejected under 35 USC 103(a) as being unpatentable over Kagiwata, above, in view of Kajita et al. as applied to claim 6 above, and further in view of Applicants alleged admitted prior art.

Applicants reiterate the comments made above with respect to Kagiwata and Kajita et al., and note that such combination does not produce Applicants disclosed and claimed structure.

There is no apparent motivation to combine Applicants discussion of the prior art which disclose fuse structures different from both Kagiwata and Kajita et al, other than Applicants disclosure. Moreover, it is impermissible to look to Applicants disclosure to ascertain a motivation to alter the prior art to arrive at Applicants disclosed and claimed invention. In addition the argument of overlapping ranges is inadequate to make out a *prima facie* case where Applicants disclosed and claimed structure has not been shown in the prior art.

"Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the

reasonable expectation of success must both be found in the prior art, and **not based on applicant's disclosure**." *In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).*

3. Claim 13 stands rejected under 35 USC 103(a) as being unpatentable over Kagiwata in view of Kajita et al. as applied to claim 9 above, and further in view of Liaw (US 6,255,715).

Applicants reiterate the comments made above with respect to Kagiwata and Kajita et al., above.

4. Claims 16-17 and 19-21 stand rejected under 35 USC 103(a) as being unpatentable over Kajita et al., above in view of Kagiwata, above.

Applicants reiterate the comments made above with respect to Kagiwata and Kajita et al. for example, neither Kagiwata nor Kajita et al., singly or in combination disclose Applicants disclosed and claimed structure as outlined above including a fuse window, Applicants metallization structure not low dielectric constant material surrounding the same.

4. Claim 18 stands rejected under 35 USC 103(a) as being unpatentable over Kajita et al. and Kagiwata as applied above, and further in view of Ying et al., above.

Applicants reiterate the comments made above with respect to

Kajita et al., Kagiwata, and Ying et al., above, and as outlined in response to the rejection of claim 10.

5. Claims 22-27 stand rejected under 35 USC 103(a) as being unpatentable over Kagiwata, Kajita et al., above, and Pricer (US 6,335,229).

Applicants reiterate the comments made above with respect to Kajita et al. and Kagiwata.

The fact the Pricer discloses directing a laser beam using overlapping ranges of wavelength as disclosed by Applicants through a low-K dielectric material does not further help Examiner in establishing a prima facie case of obviousness.

Moreover, there is not apparent motivation to combine the teachings of Kagiwata, who do not disclose a wavelength range, and disclose the criticality of a silicon nitride layer over (layer 10b over a silicon oxide layer 10a) the fuse for proper heating, through which the laser penetrates and heats up to blow the fuse, with the teachings of Pricer who disclose penetrating a different type of material and fuse structure with a laser.

Thus, having not shown Applicants disclosed and claimed structure, Examiner has no basis for arguing the obviousness of overlapping wavelength ranges which are affected by the

structure and materials of fuse structure an associated structures.

Nevertheless, even assuming *arguendo*, a proper motivation for combination, such combination does not produce Applicants disclosed and claimed invention.

Moreover, none of the cited references singly or in combination recognize or provide a solution to the problem that Applicants have recognized and solved by their disclosed and claimed invention:

"A semiconductor device fuse structure to prevent dielectric layer cracking at corner portions of associated metallization structures"

Based on the foregoing, Applicants respectfully submit that the Claims are now in condition for allowance. Such favorable action by the Examiner at an early date is respectfully solicited.

In the event that the present invention as claimed is not in a condition for allowance for any other reasons, the Examiner is respectfully invited to call the Applicants' representative at his Bloomfield Hills, Michigan office at (248) 540-4040 such that necessary action may be taken to place the application in a condition for allowance.

Respectfully submitted,

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